GEAR ALIGNMENT

CROSS-REFERENCE TO RELATED CASES

[0001] This application is a Continuation-in-Part of U.S. Patent Application No. 09/947,018, filed on 5 September 2001 and published on 10 April 2003 as U.S. PreGrant Publication No. 2003 0066371 A1 (Attorney Docket No. D/A1226).

BACKGROUND AND SUMMARY

[0002] A consistent problem with assembling gear trains is proper alignment of the gears in the train. Typically, the assembler will have to use multiple tools to perform adjustments to the train once it is assembled. If such adjustments are not made, then improper backlash can result, causing excessive wear and premature failure of the gears involved.

[0003] Further, the conventional assembly of a motor pinion gear, within backlash tolerance, to a driven gear when the driven gear is mounted on a live shaft and electrically biased requires having either too much backlash or the need for an assembly tool. Past designs incorporated brackets, cantilevered shafts, and set-up/alignment tools to ensure proper pinion to gear mesh. As many as three tolerances are added together to determine the gear mesh backlash in prior art systems, which allows the introduction of too much error into the assembly.

[0004] To aid the assembler, embodiments include a locating or guide ring coaxial with the drive shaft on the motor frame and on the same centerline as the pinion gear. The motor/locator is captured into the motor mounting bracket but has the ability to rotate through arcs, such as arcs of, for example, about 30 degrees. This allows the motor assembly to rotate on the motor mounting bracket and, with the guide ring, capture an extension of the driven gear shaft to set the proper center distance. Rotating the motor back disengages the locator from the driven shaft, and continuing to rotate the motor locks the motor relative to the motor bracket for final assembly. As a result, the

number of tolerances is reduced, the motor and bracket can be shipped in a partially assembled state and, during manufacturing, the motor and bracket can be assembled in two steps without the need for an alignment tool/feature.

BRIEF DESCRIPTION OF DRAWINGS

[0005] FIG. 1 is a perspective exploded view of an embodiment from behind a motor frame.

[0006] FIG. 2 is a perspective exploded view of an embodiment from behind a motor mounting bracket.

[0007] FIG. 3 is a perspective exploded view of an embodiment from behind a motor mounting bracket.

[0008] FIG. 4 is a schematic of an assembled embodiment.

[0009] FIG. 5 is another schematic of an assembled embodiment.

[0010] FIG. 6 is a schematic of an assembled embodiment not showing the driven shaft and gear.

DETAILED DESCRIPTION OF THE INVENTION

[0011] Embodiments include a locating or guide ring 20 on the motor frame 10 and on the same centerline as the drive shaft 11 of a motor. The guide ring 20 is captured into the motor mounting bracket 30 by, for example, a keyed aperture 31, but can rotate through arcs as large as about 30 degrees. This allows the motor assembly, including the motor frame 10 and drive shaft 11, to rotate on the motor mounting bracket 30 and capture an extension of a driven shaft 41 to set the proper center distance between the shafts 11, 41 and their centerlines. Rotating the motor assembly back disengages the locating feature 21 from the driven shaft 41. As a result, the motor and bracket can be shipped in a partially assembled state and, during manufacturing, the motor and bracket can be assembled in two steps without the need for an alignment tool/feature.

[0012] As seen in FIGS. 1 and 2, the guide ring 20 has two ears 21, 22 projecting from its outer circumferential surface. One ear 21 includes a locating feature that engages the driven gear shaft. The other ear 22 includes a detent or snap feature, such as a button, to snap the motor mounting bracket to the motor when desired. The locating feature can be, for example, a pilot diameter that can accommodate an end of the driven shaft 41 for alignment, or it can be, as an additional example, a pocket in the ear 21 that is sized to capture and align the driven shaft 41, placing it in the proper orientation for the drive and driven gears to mesh.

[0013] In embodiments, the guide ring 20 is attached to the motor frame 10, such as by a press fit. In other embodiments, the guide ring 20 is formed integrally with and as one piece with the motor frame 10, such as by casting, milling, or stamping during manufacture of the motor frame 10. There is enough space between the motor frame 10 and the ears 21, 22 of the guide ring 20 for the thickness of the mounting bracket 30.

[0014] The driven shaft includes, in embodiments, a short shaft extension concentric to the driven shaft to allow location and alignment between the bracket 30 and the driven shaft. The extension need not be very long and can be on the order of, for example, about a few millimeters. The motor assembly remains piloted by the outside diameter of the guide ring onto the mounting bracket, but the snap feature on the second ear 22 can inhabit and travel in a groove in the bracket to prevent disassembly after being snapped onto the motor.

[0015] The bracket 30 includes, in embodiments, an aperture 31 keyed for engagement and aligning the ears 21, 22 on the guide ring 20, thus allowing the user to affix the motor on the bracket 30 by rotating the motor in the pilot diameter of the bracket 30 and snapping the button into the bracket groove. The bracket 30 loosely mounts to the driven shaft frame/support so that the motor can be rotated about the driven shaft axis, bringing the locating feature in engagement with the shaft extension to ensure proper backlash in the mesh between the drive gear 12 and the driven gear 42. The bracket can then be fixed to the driven gear frame/support and the motor can be

counter-rotated to disengage the locating feature, moving it away from the locating diameter of the driven gear and solidly mounting the motor on the bracket 30.

[0016] Embodiments can have the locating feature and snap feature or detent as part of the motor frame as shown, for example, in FIG. 3. In such instances, the bracket 30 includes an aperture 31 through which the guide ring 20 extends. A locating slot that allows a shoulder screw to retain the motor on the bracket and also allow the motor to rotate about its output shaft to two fixed positions at the extreme ends of the slot. The assembly process would be substantially the same as for embodiments having the locating feature and snap feature or detent on the guide ring. The bracket with the motor assembly attached is loosely assembled to the driven shaft's frame. The motor assembly is then rotated about the output gear axis to a first extreme position in which the locating feature on the motor frame engages the driven shaft. This sets the proper center distance between the driver and the driven gear and proper backlash results. At this point, the bracket is fixed to the driven gear frame. The motor assembly is then rotated from this first extreme position, back through the initial position, and on to a second extreme position in which the detent or snap feature solidly attaches the motor to the bracket. The rotation also introduces clearance between the driven shaft and the locating feature.

[0017] Embodiments thus simplify a mounting technique for a developer drive motor. Since the motor pinion gear 12 drives its developer housing directly via helical gears 12, 42, gear-to-gear backlash and/or misalignment can arise, creating undesirable vibrations in the developer housing. These vibrations could in turn cause copy quality problems by introducing banding into the copy image on the photoreceptor at the development field.

[0018] The developer drive assembly in embodiments includes a mounting bracket 30 to be attached to the machine frame. A locator ring 20, attached to the drive motor assembly 10, such as on the front bearing hub of the drive pinion gear 12, is set to a predetermined angle to locate the drive pinion gear 12 properly with the driven gear 42, thereby ensuring that backlash is kept within a predetermined range. The locator 20 has

a section 21 including an opening, such as a rounded slot, on the pinion centerline arc and made to engage a necked down shaft extension of the driven shaft 41 on which the driven gear 42 is mounted. A pin is formed in or on the locator ring opposite the opening and engages the opening to ensure that the motor is in the correct position on the mounting bracket. The pin drops into a detent, such as a notch in the opening of the mounting bracket, when the motor and bracket are coupled prior to assembly on the machine. This engagement between the pin and detent prevents the motor assembly from rotating relative to the bracket and keeps the locator opening on the correct side of the shaft extension. The motor is secured to the mounting bracket before assembly is complete.

[0019] Prior to mounting the assembly, the developer housing is locked into position within the machine frame. To mount the developer drive motor, one places the motor assembly onto the machine back plane, inserts screws/bolts without fully tightening to allow the assembly to float somewhat. The hole pattern in the assembly matches that in the frame so that only one alignment is possible for mounting the motor assembly. One then rolls the motor counter clock wise to engage the shaft extension of the developer housing, then tightens the mounting bracket screws/bolts. Finally, the motor is rotated clockwise to line up mounting holes in the motor with mounting holes in the mounting bracket, into which screws/bolts are inserted and tighten to capture the motor to the assembly bracket.

[0020] Embodiments are particularly beneficial in device where the motor pinion gear drives the developer housing directly through helical gears. Gear to gear backlash and/or misalignment could cause unwanted vibrations in the developer housing because of the directness of the drive. These vibrations could cause copy quality problems by introducing banding into the copied image on the photoreceptor at the development field.

[0021] The drive assembly of embodiments thus includes a mounting bracket, for attachment to the machine frame with, for example, four (4) M4 x 8 mm thread cutter screws. A locator ring attached to the drive motor front bearing hub on the drive pinion

gear center line is set to a predetermined angle for locating the drive pinion gear with the driven gear and ensuring that the correct backlash is achieved. The locator section has a wide rounded slot on the pinion centerline arc that can engage the necked down shaft extension on which the driven gear is mounted.

[0022] A pin in the locator ring, opposite the slot, ensures that the motor is in the correct position on the mounting bracket. The pin drops into an opening or notch in the mounting bracket when the motor and assembly bracket are coupled, prior to assembly on the machine back plane. The pin drop prevents the motor from rotating 360 degrees and keeps the locator opening on the correct side of the shaft extension. The motor is eventually secured to the mounting bracket, for example, with three (3) thread cutter M4 screws.

[0023] According to embodiments, prior to mounting the motor assembly, the developer housing is locked into position within the machine frame. The method of mounting the motor assembly comprises placing the assembly on to the machine back plane and attaching it with, for example, the four (4) M4 screws, but do not fully tighten. By not fully tightening the screws, the assembly is allowed to float. The assembly hole pattern and matching frame pattern are such that there is only one alignment possible for mounting the assembly.

[0024] The method further comprises rotating or rolling the motor counter clock wise to engage the developer housing shaft extension with the guide slot. This aligns the motor drive shaft with the driven shaft. The method further comprises tightening the assembly mounting bracket screws and rolling the motor clockwise. In embodiments, rolling the motor clockwise lines up three mounting holes in the motor with mounting holes in the assembly mounting bracket, allowing three screws to capture the motor to the assembly bracket. This completes the assembly.

[0025] While particular embodiments have been described, alternatives, modifications, variations, improvements, and substantial equivalents that are or may be presently unforeseen may arise to applicants or others skilled in the art. Accordingly,

the appended claims as filed and as they may be amended are intended to embrace all such alternatives, modifications variations, improvements, and substantial equivalents.

We Claim: